

## **Bringing the Ocean to the Precollege Classroom through field Investigations at a National Underwater Laboratory**

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### **LONG-TERM GOAL**

Scientists from Rutgers and the Woods Hole Oceanographic Institution developed and conducted an integrated set of educational programs capitalizing on the research and technological assets of a Long-term Ecosystem Observatory (LEO-15). Activities resulting from this program engage students in real-time science to improve problem solving and critical thinking skills--essential skills to interpret, analyze, and communicate information. Our goal was to use field experiences to 1) enhance educator capability in science content and skills, 2) immerse school systems in an inquiry-driven, active learning process, and 3) establish links to real-time scientific information in support of classroom activities. Participants capability in marine science content and skills were improved through immersion in active *research-based* learning experiences, and by development of instructional Internet modules in association that focused on the summer research experiences.

### **OBJECTIVES**

The project featured a summer field program funded by the National Oceanographic Partnership Program (NOPP), where precollege educators incorporated real-time environmental information available through LEO-15 and satellite remote sensing technology into existing, interdisciplinary curricula. Objectives for the educators or participants were as follows: (1) use traditional oceanographic equipment, and *in situ* technology (Long-term Ecosystem Observatory @ 15 meters (LEO-15), remotely operated vehicles, and remote sensing technology) to conduct three small-scale research projects (phytoplankton populations, coastal upwelling, and habitat selectivity of larval fish species). (2) identify remote sensing imagery and will demonstrate a minimum of three applications to their students (3) participate in the development of hands-on classroom activities and Internet applications of the summer research projects, and (4) participate in a least two professional development conferences or school in-service where they share their experience with their peers.

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## **APPROACH**

The Summer Research Experience Program was jointly developed by the Institute of Marine & Coastal Sciences (IMCS) at Rutgers University and Woods Hole Oceanographic Institution (WHOI). Sources of support included the NOPP program, Center for Remote and Spatial Analysis (CRSSA) at Rutgers University, Geraldine R. Dodge Foundation, Research for Better Schools, GPU Nuclear, Bell Atlantic, Falmouth School District, Lacey Township School District, the Jacques Cousteau National Estuarine Research Reserve (J.C.NERR), and the Marine Remote Sensing Lab at IMCS, Rutgers University. The program was designed to develop classroom applications of the current research on-going at the Long-term Ecosystem Observatory @ 15 meters (LEO-15).

IMCS sent out a program announcement and request for participants in January of 1998 to all principals of K-12 schools in New Jersey (2,561 letters). Letters also were sent to the Falmouth School District in Massachusetts. A total of 51 applications were received. IMCS selected 45 participants based on (1) level of interest, (2) degree of commitment from the participant to follow-up with the curriculum development (evident from application cover letter and letters of support), and grade level taught. IMCS divided the group into two cohorts based on grade level, K-6 and 7-12 cohort.

The program was conducted from Sunday July 12, through Saturday July 18, 1998. These dates were chosen because the month of July is the most active time for field programs at LEO-15. The maximum level of interaction and collaboration between the educators and the LEO-15 scientists could occur at this time. Food, housing, and travel support and arrangements were provided. Participants spent the first two nights (July 12,13) on the main campus of Rutgers University where they were provided with GIS instruction and Internet skills. The remaining days were spent at a local college near the LEO-15 site where educators conducted field work. The agenda was designed to achieve the goals and objectives of the program. IMCS sent out letters (March 6, 1998) of acceptance to the program applicants. Educators not accepted were placed on a waiting list in case of cancellations.

## **WORK COMPLETED**

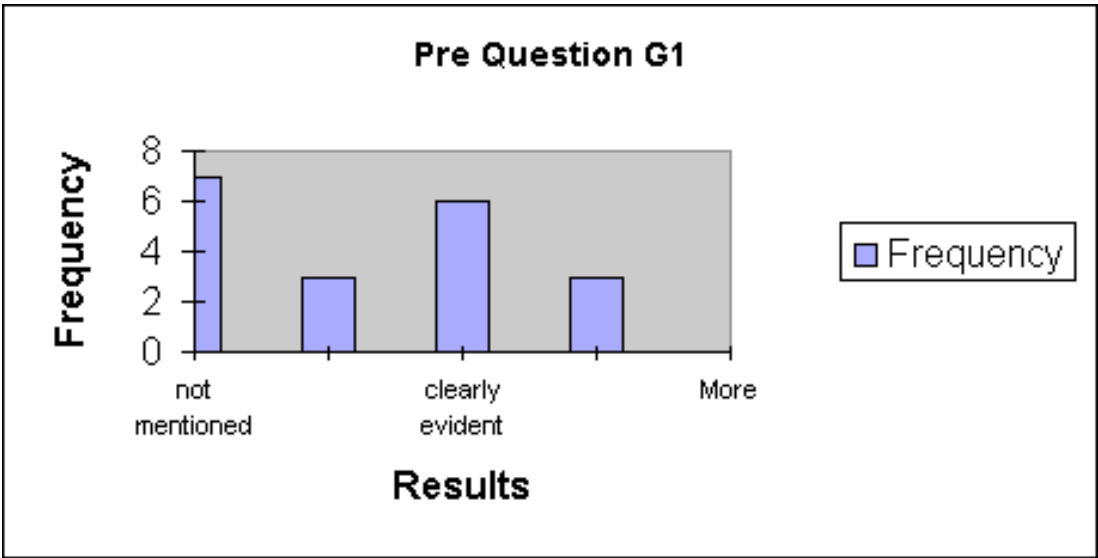
WHOI and IMCS scientists working at LEO-15 collaborated with the educators throughout the week of July 12-18, 1998. Chris von Alt involved educators in a docking exercise of the REMUS autonomously underwater vehicle. Fred Grassle provided a hands-on tour of a LEO-15 node. Oscar Schofield took the educators out on the R/V Arabella to conduct plankton tows and optical measurements. Rick Lathrop introduced the educators to GIS technology through a computer lab exercise and a ground truthing exercise in the Mullica River-Great Bay watershed (J.C. NERR).

Since the field program, educators have participated in two workshops focusing on the development of classroom applications. Five new draft lesson plans are currently listed on line at <http://marine.rutgers.edu/pt/title.htm>. Approximately thirty hands-on lessons were developed for classroom use in addition to the Internet applications. Two video conferences and several workshops are scheduled to refine the lesson plans and complete the project (see <http://marine.rutgers.edu/pt/workprm.html> for a complete list of work in progress). A no-cost extension has been granted from ONR to continue this work.

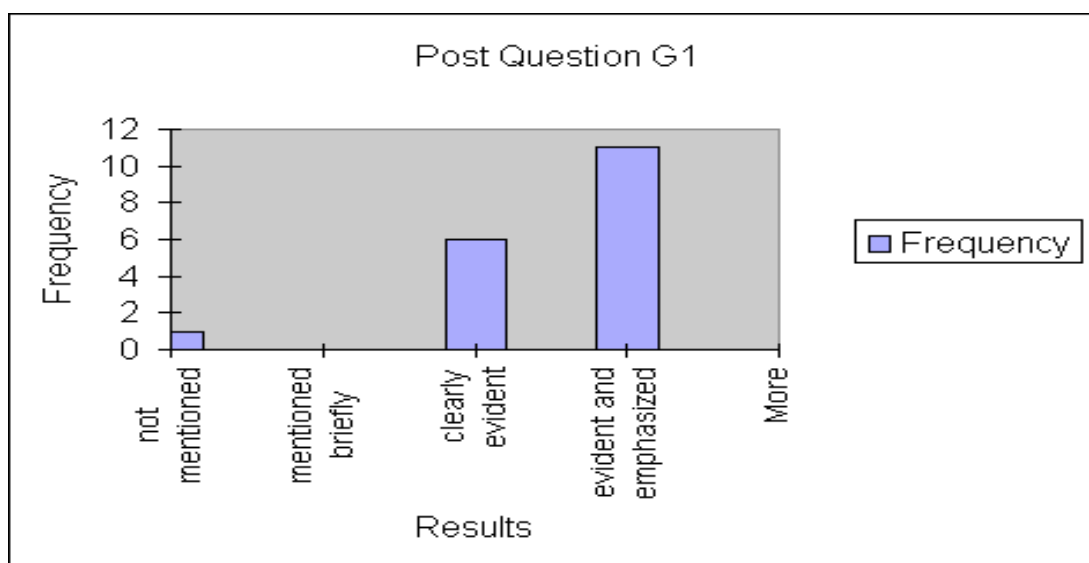
**RESULTS**

Several evaluation tools were designed by WordCraft Inc. to determine the effectiveness of "The Summer Research Experience for K-12 Educators." Changes in participant knowledge, perception, and behavior over the course of the program were the principal focus of the evaluation plan. A number of evaluation tools were developed to measure program objectives. Pre-Institute and post-Institute survey tools were designed to determine if training objectives were met. Formative interviews were conducted throughout the program to acquire participant impressions and to help training staff make mid-course corrections in the training schedule. Participants were asked to complete a Teaching Unit Description (Lesson Plan) to determine teaching methods used before and after their participation in the program. This pre- and post- survey helped to determine which strategies were learned and incorporated into each participant's teaching style. Finally, follow-up phone interviews were conducted to clarify information collected with the other evaluation tools. Special attention was given to the benefits of the program in relation to the cost.

Preliminary analysis of the Teaching Unit Evaluation has been completed. Each unit was evaluated based on the teacher's use of technology in the classroom. The following rubric was applied: 0 = not mentioned in the lesson, 1 = mentioned briefly in the lesson, 2 = clearly evident in the lesson, and 3 = clearly evident, with elaboration. Figures 1 and 2 indicates participants pre and post use of technology in the sample lesson plans.



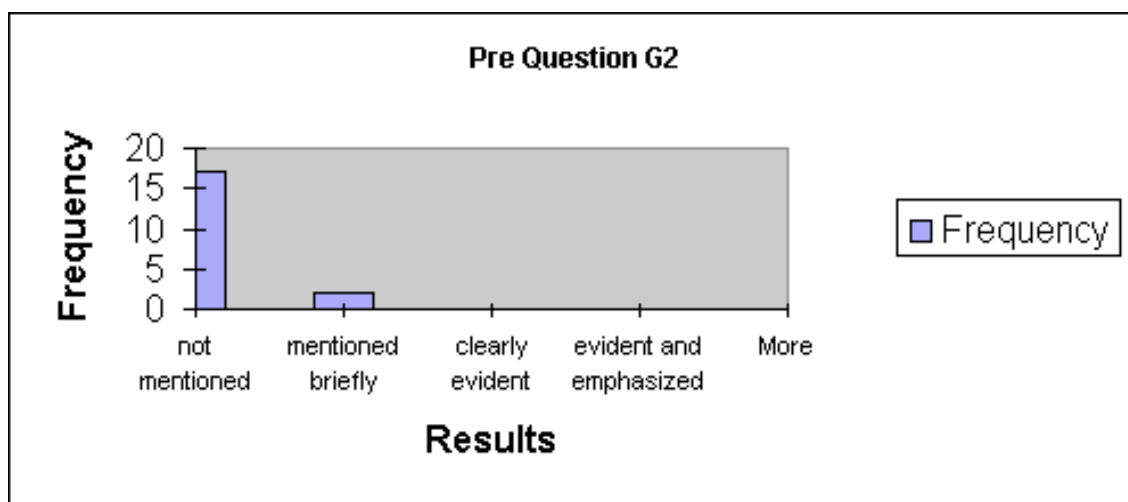
*Figure 1. Pre-Institute Lesson Plan Results - Evaluated for Use of Technology in the Classroom.*



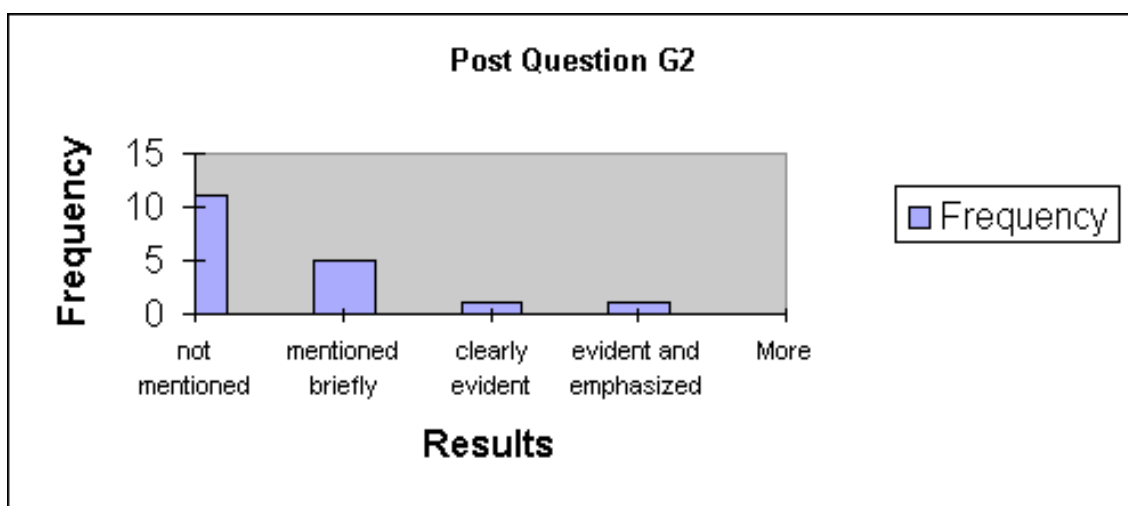
**Figure 2. Post-Institute Lesson Plan Results - Evaluated for Use of Technology in the Classroom**

Results indicate that the summer training program encouraged the participants to include technology in their classroom lessons. Prior to the training, 37% of participants did not mention technology in their lesson plans. Approximately 58% of the post -lesson plans emphasized the use of technology in the classroom.

Results also indicate that much work remains in increasing teachers' comfort level with using real-time data (via Internet) in the classroom (Figures 3 and 4). Prior to the training, 89% of the participants lesson plans did not include the use of real-time data. In post-lessons, less than 10% incorporated real-time data in their science lessons.



**Figure 3: Pre Institute Lesson Plan - Analysis for use of real-time data in the classroom.**



*Figure 4: Post Institute Lesson Plans - Analysis for use of real-time data in the classroom.*

## IMPACT / APPLICATIONS

The Summer Research Experience at LEO-15 was highly regarded by the participants. The program's most significant strength was the interaction between scientists and educators. Over 50% of the participants cited meeting and working with the scientists as the principal benefit of the program. The program increased science content knowledge and ability as well as interest in science. The success of the program appears to be based on a training program that is entertaining, educational, and practical.

IMCS and WHOI staff feel strongly that this program is a successful example of how scientists and educators can work together to spark interest and meaningful learning in the classroom. The Internet Modules short circuit the arduous rote memorization of traditional text books and allow teachers to experience the cutting edge science and technology first-hand and translate this experience to the classroom environment.

## TRANSITION

New Jersey and Massachusetts educators are currently utilizing the products developed by this project. Approximately 12,251 K-12 students are involved in the programs and the highly successful Marine Activities Resources and Education (MARE) program. The Internet products also are linked to a national audience through the Bridge Project at <http://www.marine-ed.org/>.

## RELATED PROJECTS

1 - The Bridge Web Site (VIMS) lists marine related curricula and K-12 resources related to the NOPP funded education projects.

## **PUBLICATIONS**

De Luca, Michael P., Janice D. McDonnell, Tanya Podchaski, and Cathy McBride. "Bringing the Ocean to the Classroom through Field Investigations at a National Laboratory". American Geophysical Union 1998 Fall Conference. San Francisco, CA. Volume 79, no. 45, Nov. 10, 1998, Pp F482.